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**Research Project Title: Design Considerations and Limitations of Rock Dowels/Anchors Loaded in Shear**

## Purpose of the Project

The purpose of the project is to investigate the relationship between rock joint thickness and reduced dowel shear capacity due to bending in untensioned dowels used to prevent rock slides. Most existing methods consider the effect of post-tensioning the rock bolt or anchor after the grout has set. TDOT has successfully utilized this method in the past, but the typical design method based on the pure shear capacity of the dowel fails to consider the effect of rock joint thickness, which introduces bending to the dowel.

## Scope and Significance

The scope of the research project includes:

- Survey: We will visit locations of known TDOT field applications of untensioned dowels.
- Testing: The response of the untensioned dowels subjected to shear and bending stresses will be investigated through a series of physical tests on reduced scale models of the rock discontinuity using high-strength concrete blocks. Approximately 26 tests will be completed with varying dowel diameters, joint thicknesses, and joint inclinations.
- Modeling: The behavior observed in the physical tests will be used to calibrate or tune numerical models of the un-tensioned rock dowels/rock discontinuity system, to extend the dowel size, joint thickness, and joint dip cases.
- Reporting: In addition to the quarterly reports and final report, results from the physical tests will be integrated with the results from the numerical simulations to produce a dowel capacity design chart.

## Expected Outcomes

The following are expected outcomes of this research project:

- Benefit to TDOT: This research will allow TDOT personnel responsible for developing rockfall mitigation measures to expand the application of un-tensioned rock dowels with increased confidence in their safety. Because these are more cost effective than tensioned rock anchors, a greater number of slopes can be remediated for the same cost.
- Implementing: The test results will be compiled into a *design chart for the shear capacity* of a given diameter dowel which identifies the threshold between the pure shear capacity and the reduced capacity due to bending and induced tensile effects.
- New innovation: To our knowledge, the role of bending in the dowel, which may reduce the shear capacity, has not yet been investigated. The results of this project will lead to an understanding of the nominal joint thickness above which the shear capacity must be reduced, and the development of design charts that will indicate the appropriate reduction.

## Time Period

August 01, 2019 to November 30, 2020. We are currently in the process of requesting a no-cost extension.

**Contact Information**

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